Cancer patient survival by socioeconomic status in The Netherlands: a review for six common cancer sites

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Abstract

Study objective – To study the size and consistency of socioeconomic differences in cancer patient survival as reported in published studies.

Methods – A systematic review was conducted. Several criteria were developed to select the study material, which resulted in 14 reports on socioeconomic differences in survival for cancers of the colon, rectum, lung, prostate, breast, and cervix. These present results on patients from the United States, Japan, Australia, United Kingdom, Sweden, Finland, and Germany. The results are summarised in a relative risk of dying or survival ratio for the lowest socioeconomic status group compared with the highest.

Results – For cancers of the colon, rectum, breast, and cervix, patients from higher socioeconomic status groups had a better survival. For lung cancer and cancer of the prostate, results were unclear.

Conclusion – Socioeconomic differences in cancer survival are generally small and their contribution to socioeconomic differences in cancer mortality is probably small too. These findings have implications for the type of health policy measures which should be taken to reduce socioeconomic differences in cancer mortality.

(*J Epidemiol Community Health* 1994;48:441-446)

Socioeconomic differences in mortality have been reported for a variety of causes of death including cancer.^{1,2} Cancer mortality is generally higher in people of low socioeconomic status compared with people of a high socioeconomic status. This mortality disadvantage may be the result of differences in cancer incidence or cancer survival.

Socioeconomic differences in cancer incidence and cancer survival do not call for the same health policy measures. Differences in cancer incidence ask for interventions in the area of primary prevention, whereas socioeconomic differences in cancer survival ask for policy measures in the area of secondary prevention or treatment.

We have tried to establish the size and consistency of socioeconomic differences in cancer survival, on the basis of a systematic review of the available published studies on the subject. This review deals with socioeconomic differences in cancer patient survival for a number

of common cancer sites: colon, rectum, lung prostate, breast, and cervix.

Methods

The study material was selected through Medline and the references of papers and books, which resulted in 40 papers on socioeconomic differences in cancer survival. To enable a useful comparison of the results of the reviewed studies to be made some exclusion criteria were developed.

Studies on patients diagnosed in the 1950s or earlier were excluded.

Hospital based studies were excluded because cancer patients treated in specific hospitals may not be representative of cancer patients in the general population. In particular, socioeconomic contrast may be larger in the general population than in a hospital population.

Studies covering fewer than five years of follow up were excluded, because for many cancers survival differences may not yet be apparent shortly after diagnosis.

Three measures of socioeconomic status were considered to be unfit for our purpose. Studies using race as a measure were excluded, because it is difficult to separate the impact of socioeconomic status and other race related factors on survival. Studies that used hospital type or insurance status as a measure were also excluded, as we consider both variables to be intermediary in the socioeconomic status-survival association.

Studies that reported on fewer than 200 cancer deaths were excluded from this review. This number of events is the minimum needed to indicate a relative risk (RR) of dying of 1.5 when two socioeconomic groups with equal numbers are compared (with $\alpha=0.05$ and $\beta=0.20$).³

Cancer sites for which fewer than three papers on socioeconomic status and survival were available were not considered in this review.

Finally, 14 studies remained for inclusion in the review. Table 1 presents the most important characteristics of the selected papers, which are ordered by country of origin of the study population.⁴⁻¹⁹

The country of origin of the study population may be a determinant of the strength of socioeconomic differences in cancer survival. In general, these differences are expected to be smaller in countries like Sweden, with good access to health care facilities for the entire population.

The measures of socioeconomic status are

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Accepted for publication
January 1994

divided into two broad categories: measures on the *individual* level such as education,⁸ occupation,¹⁴⁻¹⁶⁻¹⁸ or housing tenure¹³ and *ecological* measures in which the place of residence of cancer patients is used to assign a socioeconomic score. These measures are either based on census tract,⁴ block group,⁵ post-code,^{6,7,11,15} electoral ward,¹² or community of residence.¹⁹

Table 1 shows that most studies cover the 1970s and early 80s with the exception of three which cover an incidence period starting in the 60s.^{4,8,16}

From table 1 it can be seen that different measures of survival were used. If the survival of cancer patients is studied, deaths due to causes other than the cancer(s) of interest must be excluded. In a number of studies the exact cause of death was known, and therefore patients dying from other causes than the spe-

cific cancer could be treated as censored in the survival analysis. The resulting measure is called the corrected survival rate.^{4,11,15,17-19} The relative survival rate, which is the ratio of the observed and expected survival rate,^{16,17} is usually calculated when reliable information on the exact cause of death is not available. The expected survival rate is based on life tables of the general population.

A few studies did not report on the exclusion of deaths from other causes.^{5,8,12,14} In two other studies the distributions of deaths related and not related to cancer were similar in the different socioeconomic categories and the authors did not therefore correct for deaths from other causes.^{6,7} Finally, the standardised case fatality ratio was employed in one study¹³ – the case fatality rates of the entire study population for the cancer in question were used as a standard.

For most studies an RR of dying for the

Table 1 Study population, measure of socioeconomic status (SES) and measure of survival for 14 published reports on socioeconomic differences in cancer survival

Ref no	Population	Cancer site (sex)	No of patients	SES measure	Year of diagnosis	Measure of survival
4	Hawaii, USA	Colon Rectum	1446 881	Ecological: weighted score based on: average years of education and average income per census tract; 3 categories	1960–74	Corrected survival rate
5	Northwestern Washington State, USA	Breast	1506	Ecological: social class, several indicators (eg % working class) per block group of residence; 2 categories	1973–83	Survival rate*
6	USA	Prostate	2513	Ecological: education, % of high school graduates, persons ≥ 25 years, per postcode of residence; 4 categories	1977–81	Survival rate†
7	USA	Rectum Colon	1528 3617	Ecological: education, % of high school graduates, persons ≥ 25 years, per postcode of residence; 3 categories	1977–82	Survival rate†
8, 9	Boston, USA	Breast	563	Individual: education, in years of schooling; 2 categories	1965–66	Survival rate*
10	Tokyo, Japan	Breast	814	Ecological: income, median male income per postcode of residence; 3 categories	1965–67	Survival rate*
11	South Australia	Lung Colon Breast	2934 2227 2676	Ecological: occupation, % of semiskilled/unskilled workers per electoral ward; 5 categories	1977–82	Corrected survival rate
12	Sheffield, UK	Cervix	548	Individual: housing tenure; 2 categories	1971–84	Survival rate*
13	England & Wales	Breast Lung Colon Rectum Prostate Cervix	Total 17 844	Individual: social class based on occupation; 5 categories	1971–81	Standardised case fatality ratio
14	South Thames RHA UK	Cervix	1728	Ecological: unweighed average of 4 census variables (eg semi- and unskilled manual occupation) per postcode of residence; 7 categories	1977–81	Survival rate*
15	West of Scotland, UK	Cervix	1588	Individual: occupation; 2 categories	1980–87	Corrected survival rate
16	Sweden	Colon: men women Rectum: men women Prostate Lung: men women Breast Cervix Breast	3828 1946 2659 1048 4752 6587 953 11 531 4087 10 181	Individual: social class based on occupation; 4 categories	1961–79	Relative survival rate
17	Finland	Colon	2969	Ecological: score based on occupation: % of blue collar workers aged 15–65 y per community of residence; education: % with no more than 9 years schooling per community of residence; 3 categories	1971–80	Relative survival rate, Corrected survival rate
18	Finland	Colon	2969	Ecological: score based on occupation: % of blue collar workers aged 15–65 y per community of residence; education: % with no more than 9 years schooling per community of residence; 3 categories	1979–82	Corrected survival rate
19	Saarland, Germany	Colon Rectum	1465 1162	Ecological: score based on occupation: % of blue collar workers aged 15–65 y per community of residence; education: % with no more than 9 years schooling per community of residence; 3 categories	1974–83	Corrected survival rate

* Whether a correction for other causes of death than the cancer was made is unknown.

† No correction for other causes of death was made because the distributions of deaths related and not related to cancer were similar in the various socioeconomic status categories.

lowest compared with the highest socioeconomic status category was taken directly from the paper.^{5-7 11 15 17-19} For two studies,^{8 12} we calculated an RR of dying with 95% confidence intervals (95%CI).²⁰ For one study, the ratios of standardised fatality rates were calculated; these are presented for men and women separately.¹³ For two studies we present a survival ratio,^{4 16} because an RR of dying could not be calculated. A survival ratio is the ratio of the survival rate of the lowest to the highest socioeconomic status group and indicates worse survival for the lowest group if it is below 1.00.

For one study, only graphs were presented in the paper.¹⁶ We therefore obtained the original life tables from which five year relative survival rates had been abstracted and calculated 95% CIs from these.²¹

In some studies in which no survival differences were found no information was given on the exact RR or survival rates.^{11 14}

For most studies we used the number of socioeconomic status categories originally distinguished by the authors. For one study,⁸ we reduced the original number of four categories to two, to provide a sufficient number of patients per category.

Results

Table 2 shows the results of the selected papers ordered by cancer site.

COLON CANCER

For colon cancer seven studies were included in

the review. Two studies showed no association between socioeconomic status and survival.^{7 16} The other five studies all indicated a small survival advantage for colon cancer patients from the higher socioeconomic group.^{4 11 13 18 19} In one of these studies the survival difference was not statistically significant at the 5% level,⁴ while in another only the raised RR for men was statistically significant.¹³ Finally, in one study there was no information on statistical significance.¹⁸

RECTAL CANCER

For cancer of the rectum, five studies are presented in table 2. Differences in survival were apparent in one study,¹⁹ in which the RR of dying in the lowest compared with the highest socioeconomic status group was statistically significantly (<0.05) larger than 1.00. Three other studies also showed worse survival for the lowest socioeconomic status group,^{4 7 16} although in two studies this was not a statistically significant difference,^{4 7} and in the third study this was only the case for men.¹⁶ Finally, one study showed (not statistically significant) opposite results for men (RR = 1.18) and women (RR = 0.82).¹³

LUNG CANCER

In the case of lung cancer, two studies presented a small, not statistically significant survival advantage for the highest socioeconomic status

Table 2 Results expressed as relative risk (RR) or survival ratio (SR) for the lowest relative to the highest socioeconomic status group

Study ref	RR of dying (95% CI) or p value	SR (95% CI) or p value	Adjusted for
Colon:			
4		0.82 (0.66, 1.02)	Age, sex, race, stage
7	0.97 (p>0.05)		Age, sex, race, stage
11	1.26 (1.04, 1.52)		Age, place of residence
13	M: 1.44 (p<0.05) F: 1.11 (p>0.05)		Age, period of follow up
16		M, F: 1.00 (p>0.05)*	
18	1.15†		Age, sex, follow up year
19	1.22 (1.01, 1.47)		Age, sex, stage, year of diagnosis, region, district
Rectum:			
4		0.79 (0.60, 1.05)	Age, sex, stage, race
7	1.09 (p>0.05)		Age, sex, stage, race
13	M: 1.18 (p>0.05) F: 0.82 (p>0.05)		Age, period of follow up
16		M: 0.83 (p<0.05) F: 0.91 (p>0.05)*	
19	1.32 (1.09-1.60)		Age, sex, stage, year of diagnosis, region, district
Lung:			
11	No difference†		Age, histology, birth place
13	M: 1.08 (p>0.05) F: 1.13 (p>0.05)		Age, period of follow up
16		M: 0.93 (p>0.05) F: 0.90 (p>0.05)*	
Prostate:			
6	1.86 (p=0.03)		Age, race
13	0.91 (p>0.05)		Age, period of follow up
16		0.94 (p>0.05)*	
Breast:			
5	1.52 (1.28, 1.88)		Age, race, tumour, stage, histology
8	Boston: 1.32 (1.08, 1.61) Tokyo: 1.30 (0.91, 1.86)		Age
11	1.35 (1.04, 1.74)		Age, histology
13	0.98 (p>0.05)		Age, period of follow up
16		0.91 (p<0.05)*	
17	1.28 (p<0.05)		Age, period of diagnosis, follow up year
Cervix:			
12	1.1 (0.99, 1.23)		Age, tumour stage
14	No difference (p>0.05)		Age, tumour stage, histology, tumour grade, health board, year of treatment
15	1.11 (0.64, 1.92)		
16		0.91 (p<0.05)*	

M = male, F = female,

* p value for this study <0.05 when the 95% CI for 5 year relative survival rate for the two socioeconomic status groups do not overlap.

† p value not reported

group.^{13 16} In one other study it was only mentioned that no survival difference was found.¹¹

PROSTATIC CANCER

For cancer of the prostate one study found a rather high RR of dying for the lowest socioeconomic status category ($p=0.03$).⁶ The results of the two other studies showed either a slight, not statistically significant, survival advantage for the lowest socioeconomic status category¹³ or for the highest socioeconomic status category.¹⁶

BREAST CANCER

Data on socioeconomic differences in breast cancer survival come from six studies in this review. Except for one study,¹³ these all showed a raised RR of dying for patients with the lowest socioeconomic status.^{5 8 11 16 17} However, the results for Japan in one study were not statistically significant.⁸

CERVICAL CANCER

Finally, for cancer of the cervix only one study showed a statistically significant higher survival rate for the highest socioeconomic status group.¹⁶ Two studies showed a slight survival advantage for the highest socioeconomic status group, which was not statistically significant,^{12 15} while in the fourth study no difference in survival between socioeconomic groups was found.¹⁴

Discussion

We have reviewed results from 14 studies on socioeconomic differences in survival for six cancer sites. As can be seen from table 2, survival differences are generally rather small. Furthermore, results differ in relation to the cancer site. With regard to the results, we distinguished between three types of studies: (1) those showing a statistically significant difference in survival; (2) studies showing survival differences, which are not statistically significant; and (3) studies showing no survival difference according to socioeconomic status.

For cancers of the breast, colon, rectum, and cervix, most studies showed better survival for patients from higher socioeconomic groups. For these cancers all the statistically significant differences suggested a survival advantage for those of higher socioeconomic status, and most of the non-significant differences agreed with this.

The results are unclear both for lung cancer and cancer of the prostate. For lung cancer, only small, non-significant survival differences were found in two studies,^{13 16} with the higher socioeconomic status groups showing an advantage, while no difference was found in the third study.¹¹ For cancer of the prostate, the results of one study which showed significantly better survival for the higher socioeconomic status group,⁶ were contradicted by one¹³ of two studies that showed non-significant results.

In general, socioeconomic survival differ-

ences are thought to be larger in cancers of relatively good prognosis,²² as earlier detection and treatment can be of greater influence on the survival for these cancers. This is more or less confirmed by our review, although the picture is less clear than expected.

For breast cancer, overall survival is rather good²³ and survival differences are relatively large. For lung cancer, which has the lowest overall survival probability of the six cancers studied,²³ very small survival differences were found. The remaining four cancer sites have an intermediate level of survival.²³ For cancers of the colon, rectum, and cervix survival differences according to socioeconomic status were found, which is in concordance with their overall level of survival. For cancer of the prostate, which has a better overall survival than colonic cancer, the results are less clear.

The general pattern of socioeconomic survival differences described above seems to be quite coherent. However, the results of the separate studies may have been influenced by their study design (for example, study population, measure of socioeconomic status, period of diagnosis) and data analysis (for example, number of other factors for which adjustment was made in the survival analysis, the reporting of confidence intervals). We will mention briefly some of the differences in study design and data analysis.

As we have already stated, study results might depend on the country of origin of the study population. We did not observe a systematic difference, however, in study results per country. Another important feature of study design concerns the measure of socioeconomic status which is used in a study. In general, ecological measures are more prone to misclassification than measures based on individual characteristics. This misclassification is probably not related to the outcome and therefore results in a bias towards the null hypothesis. For example, in one study the measure of socioeconomic status was based on the median male income per postcode of residence.¹¹ This measure was also applied to female survival data, thereby causing even more probable misclassification.

Some individual measures of socioeconomic status, such as housing tenure,¹³ are only rough indicators. This could account for the inconsistency of the results from this study with those from other studies, for example, for breast cancer.

Overall, studies using an ecological measure^{4-7 11 12 15 19} did not differ substantially in their results from those using an individual measure.^{8 13 14 16-18}

The measure of outcome employed in a study on socioeconomic status and cancer survival is another characteristic which may influence the study results. In studies using the relative survival rate as outcome, the expected survival rate is based on life tables of the general population. However, life expectancy of people from lower socioeconomic groups is lower than life expectancy of the general population. Therefore, their relative survival rate is underestimated, while for higher socioeconomic groups it is

overestimated. Karjalainen and Pukkala¹⁷ compared socioeconomic differences in relative and corrected survival rates and showed that by using the relative rate the absolute difference in rates between the highest and lowest social class was larger. An overestimation of socioeconomic differences in cancer patient survival can thus result from using the relative survival rate, as in the Swedish study.¹⁶ For cancer of the cervix only, however, this study does¹⁶ show a larger difference in survival according to socioeconomic status than the other studies.^{12 14 15}

Although it was not clear whether correction for deaths from causes other than cancer was made in four studies,^{5 8 12 14} results of these studies did not differ substantially from those of other studies.

The number and type of variables for which adjustment in the survival analysis was made also varied across studies, which made a comparison of results rather difficult. For cervical cancer, however, the results from three UK studies are consistent, although in the analysis of one study adjustment was made for many variables,¹⁵ while in two other studies this was not the case.^{12 14}

It is important to know, as we noted in the introduction, whether socioeconomic differences in cancer mortality are mainly caused by incidence or survival differentials. We therefore compared our findings on survival with published data on cancer mortality according to socioeconomic status for the six cancer sites which were studied. The selected studies concern patients diagnosed between the second half of the 1960s and the beginning of the 1980s in Finland,¹ Australia,^{24 25} New Zealand,²⁶ Switzerland,²⁷ the UK,^{28–30} and the USA.³¹

For rectal cancer no association exists between socioeconomic status and mortality.^{25 26 30} Mortality is higher in lower socioeconomic groups for cancers of the lung^{1 24–30} and cervix.^{1 25 27 29} For cancers of the colon, prostate, and breast, either no mortality differences were found (colon,^{25 30} prostate,^{26 29 31} breast^{27 29}) or there was higher mortality in higher socioeconomic status groups (colon^{24 26}, prostate^{25 27 30}, breast^{1 25}).

If we compare our findings on cancer survival with the published data on socioeconomic differences in cancer mortality, we come to the following conclusions.

For lung cancer, the higher mortality in the lower socioeconomic groups cannot be ascribed to socioeconomic differences in survival, which seemed to be rather small and insignificant. Mortality differences must therefore be the result of differences in incidence. This is confirmed by findings from studies on socioeconomic status and lung cancer incidence, which showed a higher incidence for the socially disadvantaged.^{25 29 32 33}

For cancer of the cervix, higher mortality was found for the lower socioeconomic groups, while small survival differences were found in the reviewed papers for this cancer. These mortality differences must therefore be the result of the socioeconomic differences in cancer incidence which have been reported in several

studies and which indicate a higher incidence in the lower socioeconomic status groups.^{25 29 33 34}

For cancers of the breast and colon, mortality was higher in higher socioeconomic status groups in some, but not all, studies, while survival seemed to be better in these groups. Thus, for these cancers, the better survival for patients from higher socioeconomic status groups could somewhat weaken the positive association between socioeconomic status and mortality, or make it totally disappear in some situations. The incidence for these cancers is higher in the higher socioeconomic status groups (breast,^{25 33 34 35} colon^{25 33 35}) which confirms that mortality differences for these cancers are also mainly caused by differences in incidence.

For rectal cancer, no socioeconomic gradient in mortality was found, but survival differences do exist. With regard to incidence too, no socioeconomic gradient was found,^{25 33} which makes the evidence on the impact of incidence and survival differences according to socioeconomic status on mortality differences rather inconclusive.

Finally for cancer of the prostate mortality was higher in higher socioeconomic status groups in some studies, while results on survival were inconsistent. The mortality differences according to socioeconomic status for this cancer seem to be caused by socioeconomic differences in incidence. This is confirmed by the finding in several studies that the incidence of this cancer is higher in men from high socioeconomic groups.^{25 33 35 36}

We conclude that overall the impact of socioeconomic differences in cancer survival on differences in cancer mortality is low. Socioeconomic differences in cancer mortality are mainly caused by differences in incidence. Health policy measures in the field of primary prevention aimed at known cancer risk factors should therefore be taken to reduce socioeconomic differences in cancer mortality.

The authors thank D Vägerö who kindly supplied the original life tables from his published study.

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Cancer patient survival by socioeconomic status in seven countries: a review for six common cancer sites

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Abstract

Study objective - To study the size and consistency of socioeconomic differences in cancer patient survival as reported in published studies.

Methods - A systematic review was conducted. Several criteria were developed to select the study material, which resulted in 14 reports on socioeconomic differences in survival for cancers of the colon, rectum, lung, prostate, breast, and cervix. These present results on patients from the United States, Japan, Australia, United Kingdom, Sweden, Finland, and Germany. The results are summarised in a relative risk of dying or survival ratio for

the lowest socioeconomic status group compared with the highest.

Results - For cancers of the colon, rectum, breast, and cervix, patients from higher socioeconomic status groups had a better survival. For lung cancer and cancer of the prostate, results were unclear.

Conclusion - Socioeconomic differences in cancer survival are generally small and their contribution to socioeconomic differences in cancer mortality is probably small too. These findings have implications for the type of health policy measures which should be taken to reduce socioeconomic differences in cancer mortality.

Corrigendum: An article was published in the October issue entitled "Cancer patient survival by socioeconomic status in The Netherlands: a review for six common cancer sites" (*J Epidemiol Community Health* 1994; 48: 441-6). This title was incorrect and misleading. The corrected title is printed above, together with the abstract.